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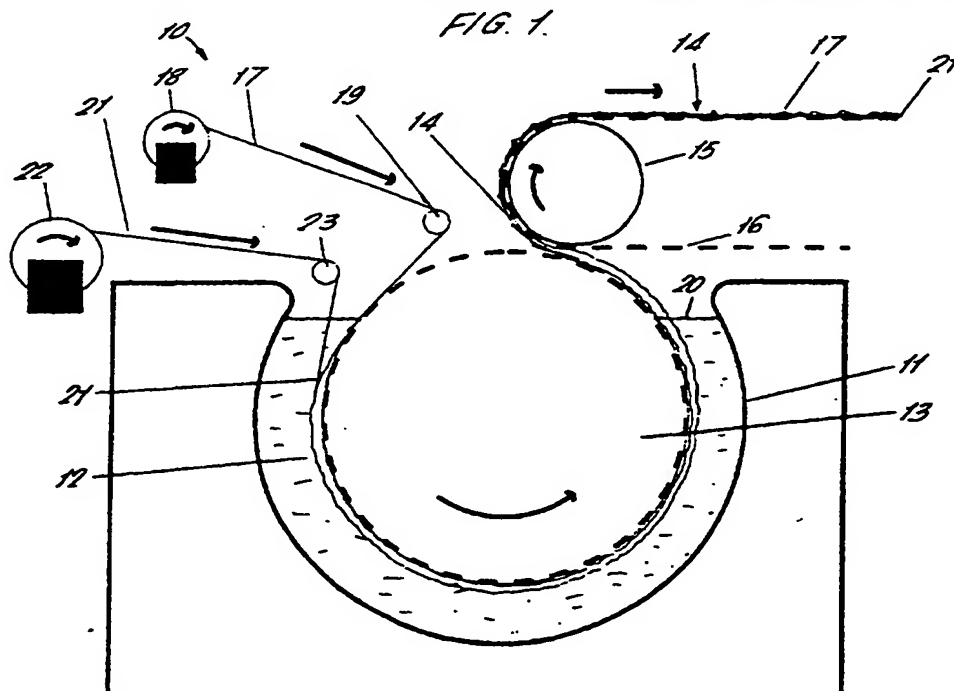
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(56) Documents Cited
GB 2260772 A GB 2103669 A GB 1365876 A
EP 0070172 A1 EP 0059056 A1 US 1921504 A

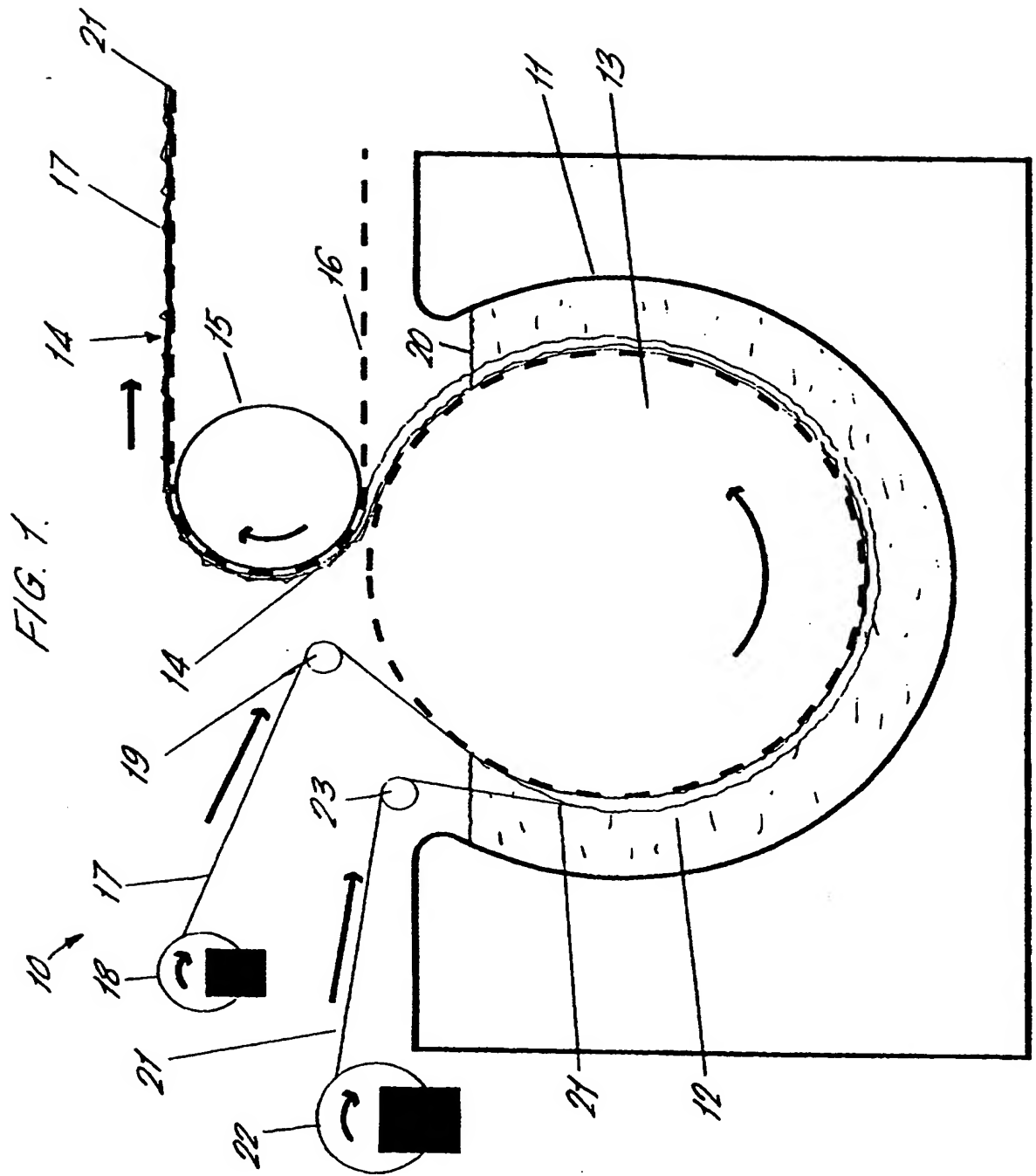
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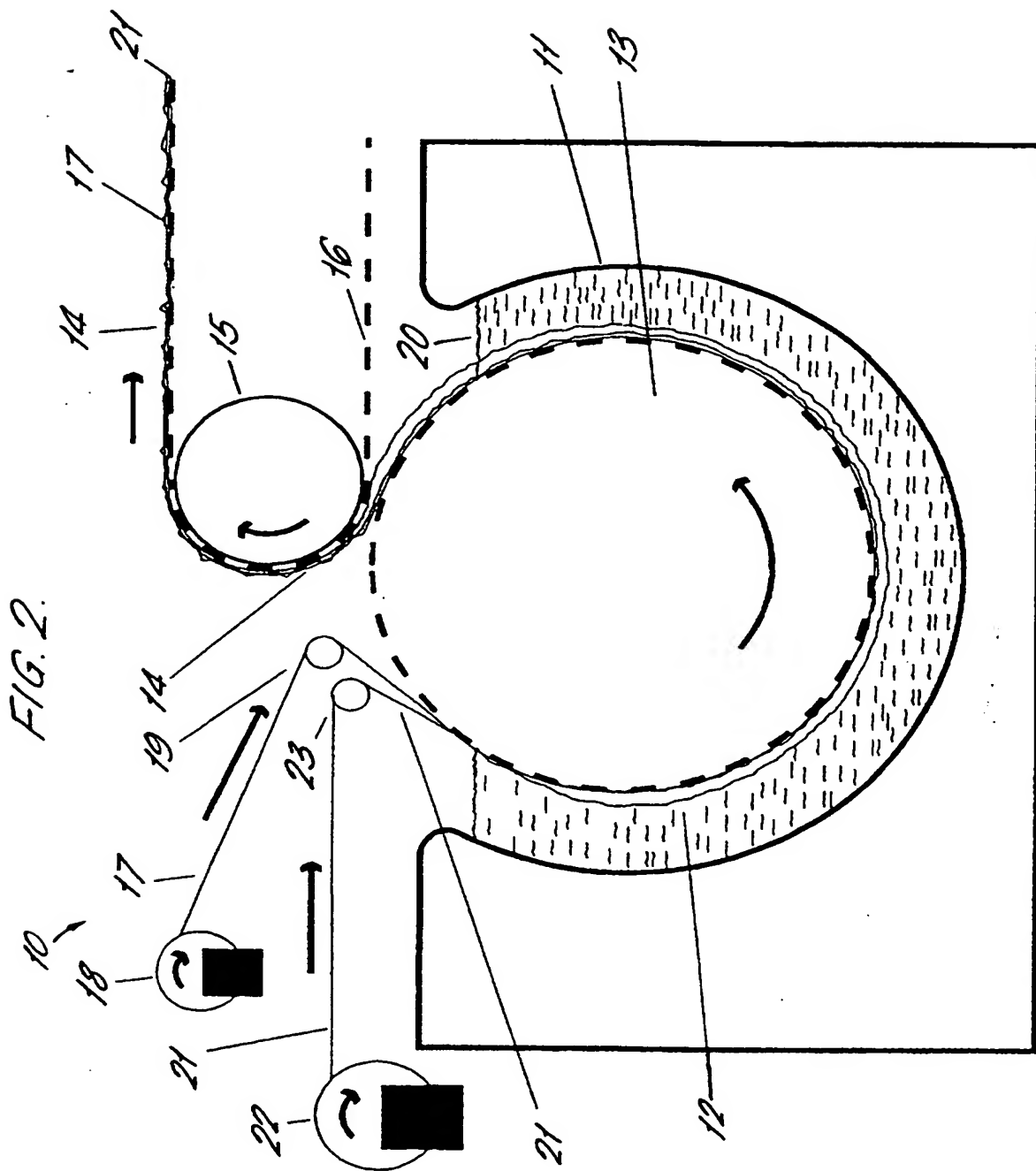
(54) Reinforced paper incorporating a security element

(57) Security paper is made incorporating an elongate security element (17) and a reinforcing strip (21) which is formed with meshes therein and is embedded in the paper. The security element may be exposed at windows in the paper or may be totally covered. The element (17) and strip (21) may be fed to the cylinder mould either separately (as shown), together or in a pre-bonded state. The strip (21) may be partially soluble, provided with an adhesive coating or made of hot-melt adhesive to enhance bonding with the paper fibres.



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FIG. 3.

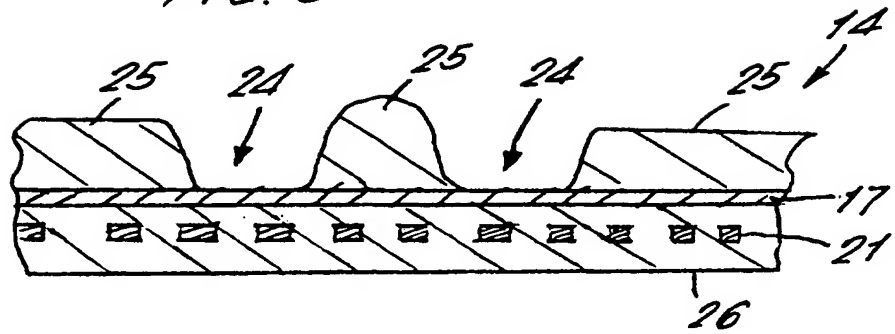
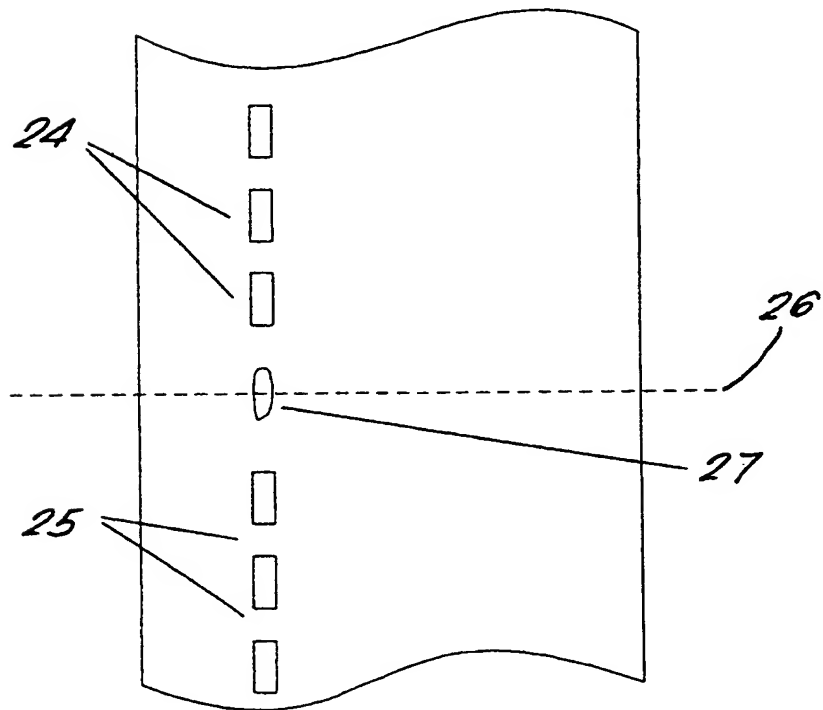
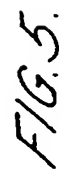


FIG. 4.





REINFORCED WINDOWED PAPER
INCORPORATING A SECURITY ELEMENT

5 The invention is directed at improvements in
windowed paper incorporating an elongate security
element, and to a method of making reinforced windowed
paper incorporating an elongate security element.

10 It is generally known to include, as a security
feature, elongate security elements such as threads,
strips or ribbons of, for example, plastics film,
metal foil, metallised plastics or metal wire, in the
thickness of security paper to render imitation of
documents produced from that paper more difficult. To
15 increase the security provided by the inclusion of
such an elongate element, it is also known to endow
the element itself with one or more verifiable
properties over and above its presence or absence.
Such additional properties include magnetic
properties, electrical conductivity, the ability to
20 absorb x-rays and fluorescence.

25 As a further security feature, it has been found
to be particularly advantageous to provide windows in
the surface of the paper which expose such elongate
elements at spaced locations. Examples of methods of
manufacturing such paper incorporating security
elements with or without windows are described below.
It should be noted that references to "windowed thread
paper" include windowed paper incorporating any
elongate security element.

30 EP 0059056 describes a method for manufacture of
windowed thread paper on a cylinder mould papermaking
machine. The technique involves embossing the
cylinder mould cover and bringing an elongate element
into contact with the raised regions of the embossing
35 prior to the contact entry point into a vat of aqueous

stock. Where the elongate element makes intimate contact with the raised regions of the embossing, no fibre deposition can occur. After the paper is fully formed and couched from the cylinder mould cover, these contact points are present as exposed regions which ultimately form windows in the finished banknote paper.

WO 93/08327 describes a method of manufacturing windowed thread paper on a Fourdrinier papermaking machine. A rotating embedment means with a modified profile or embossing is used to drive an elongate element into draining stock on a fourdrinier wire. The profile of the embedment means is such that raised portions are provided which remain in contact with the elongate element during the embedment process. Thus fibres are prevented from collecting between the element and embedment means such that the elongate element is subsequently exposed in windowed regions of paper.

EP 0070172 describes a method of forming paper involving the use of a security device in the form of a strip having first regions which are relatively impermeable and second regions which permit drainage of the liquid from the papermaking stock through the strip such that the impermeable regions inhibit deposition of fibre and thus become exposed in the finished sheet.

GB 1365876 describes the incorporation into security paper as a security device of a porous plastic mesh which may be coloured and which is subsequently detectable by both visual and tactile means.

FR 2702228 describes the manufacture of a security document with a water-soluble ribbon bearing markings visible in reflected light. The ribbon is

invisible when viewed in transmitted light.

EP 0625431 describes the manufacture of paper on a multi-ply machine incorporating security strips of a width exceeding 2mm. This specification states that, in the absence of multi-ply techniques, the use of security strips of width approximately 1.5-2.0mm produces defects (holes) on the back of the sheet, i.e. the side away from the mould cover without, however, the same defects occurring on the side of the paper facing the mould cover. According to this specification, defects on the front side of the paper, i.e. the side facing the mould cover, only occur when the width of the security strip is increased to approximately 4-5mm. The technique also describes the use of liquid permeable areas in the edge of the area of the security strip for use on even wider security strips. These liquid permeable edge regions provide anchorage for the security strip in the paper.

The use of elongate security elements in the security paper made by the known techniques can lead to a relative weakness in the mechanical strength of the finished paper or banknote. This is particularly relevant to the wider threads being used nowadays of 1.6mm upwards. When a banknote is folded in the vicinity of the elongate element, there is a tendency for the fold to occur directly alongside the elongate security element which is itself relatively rigid. Thus the edge of the element tends to act as a stress concentration point. The fibre is in places locally thinner against the edge of the element than in the general body of the sheet. Thus when the sheet is folded, the effect of stress concentration and thin fibre can lead to a weakness and tendency to tear down the side of the elongate security element. Similarly, when a tensile force is applied substantially at right

angles to the elongate security element, the localised regions of thin fibre will tend to make the note tear preferentially in the vicinity of the elongate security element.

5 The use of meshes as support and strengthening for security paper is well known in the industry. GB 3453 describes the use of an open mesh fabric as support across the width of the note. US 1921504 defines a method of incorporating a textile mesh into
10 secure documents for reinforcement on a Fourdrinier machine. However, none of these methods is suitable for reinforcing paper incorporating security threads.

It is therefore an object of the present invention to provide a reinforced paper incorporating
15 a security element and a method of making same.

The invention therefore provides a reinforced fibrous sheet comprising an elongate security element and a reinforcing strip of material having openings therein substantially embedded in the sheet between
20 the elongate element and one surface of the sheet.

The invention also provides a method of making a reinforced fibrous sheet generally incorporating a continuous elongate security element comprising the steps of continuously depositing fibres onto a support
25 surface to form a sheet, continuously introducing an elongate element and a reinforcing strip of a material having openings therein such that the elongate element is at least partially embedded within the sheet and the reinforcing strip lies between the elongate
30 element and one surface of the sheet.

The use of a reinforcing strip leads to the mechanical reinforcement of the known weak areas of banknotes and other security documents formed from the paper and enhances resistance to tearing due to
35 prolonged/repeated folding and also a transverse

tensile force.

The invention will now be described, by way of example only, with reference to the accompanying drawings in which:-

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Fig. 1 is a schematic section through a cylinder-style mould papermaking machine for use in the method according to the present invention;

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Fig. 2 is a schematic section similar to that of Fig. 1, but showing an alternative point of introduction of the reinforcing strip;

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Fig. 3 is an enlarged cross-section of a piece of paper made by the method of the present invention;

Fig. 4 is a plan view of windowed thread paper of the prior art; and

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Fig. 5 is a further schematic section similar to that of Figs. 1 and 2 showing yet another alternative point of introduction of the reinforcing strip and elongate element.

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As seen in Fig. 1 a cylinder mould papermaking machine 10, which can be used in the method of the present invention, comprises a vat 11 containing an aqueous fibre stock 12 consisting of a suspension of papermaking fibres. The paper may be made from natural or synthetic fibres or a mixture of both. A cylinder mould 13, arranged with its axis in the horizontal plane, is positioned so that the major portion dips into the vat 11. The surface of the cylinder mould 13 is provided by a wire mesh known as the cylinder mould cover. Generally there are several

layers of mesh employed, the outermost being finest. Liquid is drawn through the mesh as the cylinder mould 13 is rotated causing papermaking fibres to deposit on the mesh and form a sheet 14 which is couched from the cylinder mould 13 by couch roll 15 and is conveyed away on the couch fabric 16. When making windowed paper, the surface of the cover of the cylinder mould 13 is provided with raised portions as described in EP 0059056.

10 An elongate security element 17 is continuously implanted in the paper. The security element 17 can be of any type, including threads or strips that are metallised, demetallised, holographic, microprinted, dichroic etc. The element 17 is supplied from a
15 bobbin 18 and passes over a guide 19, such as a roller, into contact with the cylinder mould 13. For the windowed paper the element 17 is led into the vat 11 so as to contact each raised portion before the raised portion enters the vat 11, i.e. whilst still
20 above the water level 20 so that the elongate element 17 is laying over the raised portion as fibres begin to deposit. Fibres are progressively deposited over the element 17 and also below the level of the element 17 except at the raised portions. For non-windowed
25 paper the element 17 is led into the vat 11 after fibres have been deposited on the cylinder mould.

A reinforcing strip 21 is also continuously implanted in the paper. The reinforcing strip 21 has openings therein and may be in the form of a mesh
30 tape, or perforated strip or other appropriate construction. The reinforced strip 21 used in accordance with the invention preferably have widths of 10-20mm, although those having greater and smaller widths may also be used. The strip 21 is preferably
35 in tape form and is unwound from a spool 22 and

transported over a suitable guide 23 to preferably be run into the vat 11 below the water level 20 behind the elongate element 17, i.e. on the opposite side of the element 17 to the cylinder mould 13. As some
5 fibres have already covered the elongate element 17 and the fibrous stock 12 may drain through the reinforcing strip 21, fibre is deposited both between the reinforcing strip 21 and the elongate element 17 and behind the reinforcing strip 21 so that it is
10 wholly buried. Thus the reinforcing strip 21 is substantially incorporated within the body of the paper sheet 14 and surrounded by paper fibres.

The reinforcing strip 21 may alternatively be introduced into the vat 11 together with the security
15 element 17 as shown in Fig. 2. As a further alternative, the thread 17 and strip 21 may be intimately bonded prior to insertion into the paper and inserted in the manner represented by numeral 17 in Fig. 1. There is then no need for a separate
20 reinforcing strip represented by numeral 21 in Fig. 1.

It should be noted that other methods of making paper may be used in the present invention using other types of papermaking machines such as a fourdrinier
25 machine. The means of introduction of the security element 17 and reinforcing mesh tape 21 may vary on such other machines.

The construction of a final paper sheet 14 according to the invention, containing windows, can be seen in Fig. 3 on an exaggerated scale. Where the
30 security element 17 was in contact with a raised portion on the cylinder mould 13, the element 17 lies exposed on one surface of the paper 14 (i.e. the mould side). These exposed areas form the windows 24 and the areas between the windows 24 are bridges 25 where
35 complete coverage of the element 17 with paper fibre

has been effected. The strip 21 is completely embedded in the paper 14 between the element 17 and the non-windowed surface 26 of the paper.

Suitable mesh tapes for use as the reinforcing strip in this invention are:

Smith & Nephew Tape R769
 Net 909

10- Bondina Fabric 1703 polyamide
 MT 1235
 MT 1236
 MT 1237

15 The mesh tape may be wholly insoluble or partially soluble. The latter may be made from polyvinyl alcohol which, under the action of heat/moisture in the paper forming and/or drying processes will soften on the outside and allow a more intimate bond with the paper fibre. Alternately the mesh may be treated with a coating or by other means, or include minute hairs or the like to promote adhesion to the paper fibre. A further option is the use of meshes formed from hot-melt adhesives which are

20 available as sheets, nets or mesh webs. Examples of such materials are Xiroweb™ thermoplastic bonding adhesive webs from Sarnatech-Xiro AG; the webs or films comprise copolyamide, terpolymers based on polyethylene vinylacetate, modified polyethylene, polypropylene, modified polyolefins, polyester and composite films thereof. Where such films are

30 supplied as continuous impermeable sheets, they must be perforated and slit to the necessary mesh width prior to the papermaking processes described herein.

35 The thickness of the mesh tape or other type of

strip and the dimensions of its openings are preferably such that, in the finished paper, they provide a tactile effect.

5 In addition to the mechanical reinforcement of paper made by this method, there are other surprising and wholly unexpected technical benefits. Contrary to the comments made in DE 4314380, which states that defects/holes only occur on the front side of the paper sheet when the width of the security strip is increased to approximately 4-5mm, it has been found 10 that defects/holes can occur on the front side at width ranges substantially below this value. It has been observed that paper fibre is correctly deposited in the bridge 25 and inter-note regions around the cut 15 line 26 between notes (see Fig. 4) on the cylinder mould 13 and that fibre coverage is complete when the wet paper is couched off the cylinder mould 13. However, when the paper on its carrier couch fabric 16 is passed through a conventional single felt press 20 section with the felt on the underside of the paper, i.e. the opposite side to the windows in which the security element is exposed, damage to the fibre coverage on the front side can occur in the bridge 25 and inter-note regions to produce holes 27, i.e. 25 unwanted exposure of the security element in these regions. The effect is associated with a relatively high moisture content in the paper proceeding the press section.

30 It has been found that the use of reinforcing strips 21 in accordance with the present invention substantially reduces this tendency. High pressures are generated within the moist fibre coverage over the security strip at the press nip; since the water squeezed out of the fibrous coverage by this pressure 35 cannot pass through the impermeable security strip, it

is transported along the strip and sideways across the strip to the edges of the strip where it can be forced through the paper and into the supporting press felt. The effect of this action is to disrupt the fibre coverage over the security strip. To a significant extent, the unwanted holes 27 in the bridge 25 inter-note regions on the front surface appear to be due to adhesion of the disrupted region of pressed fibre to the press roll surface as the paper on its carrier fabric is removed at the outgoing nip. It has been found that the presence of a reinforcing strip 21 inhibits the propensity of the paper fibre to follow the path of the press roll at this point and thus plays a significant role in keeping the paper sheet 14 consolidated. This effect was entirely unexpected prior to the experimental trials leading to the present invention.

A further unexpected technical benefit is that in the absence of a reinforcing strip, the passage of water forced through the paper adjacent to the security strip displaces fibre and produces very thin paper or holes alongside the strip. These thin regions or holes are visually unacceptable as well as constituting regions of mechanical weakness. It has been found that the use of reinforcing strips as described herein prevents the formation of such thin regions or holes by inhibiting the fibre displacement that otherwise occurs during the pressing operation.

For the purposes of restricting the formation of thin fibre coverage or holes over or alongside the thread during pressing, the reinforcing strip may be made from a material, e.g. a suitable grade of polyvinyl alcohol, such that the strip is wholly or substantially dissolved and incorporated within the body of the sheet during the drying operation, in a

manner similar to that described for dissolving security strips in US 4552617. However, the benefits of subsequent mechanical reinforcement of the finished document against damage due to folding/tearing are then not available when such dissolving meshes are used.

Thus the use of a reinforcing strip 21 not only assists the finished product resist damage due to mechanical flexing etc., it has the additional highly valuable benefit in consolidating the sheet through the manufacturing process. A third benefit is that the reinforcing mesh 21 provides a distinct tactile effect to the finished document which is a valuable addition to the overall public security.

As mentioned previously, the reinforcing strip 21 may comprise a perforated strip. Such perforations may be produced mechanically by punching, using laser drills, electrical sparking or other known means. Such perforated film is in common use in other fields e.g. for wrapping bread.

As well as providing mechanical reinforcement to windowed thread paper, the invention is also of value in providing reinforcement to paper where the security element is wholly enclosed within the sheet; the reinforcing strip may be introduced behind the embedded security element as shown in Fig. 5, or the security element may be bonded to the reinforcing strip.

The use of reinforcing strip as described in this specification is particularly beneficial for paper incorporating security elements in the width range 1.0-4.0mm, although it is also beneficial to security elements of width outside this range.

Apart from the benefits of mechanical reinforcement and reduction of elimination of the

production of thin regions of paper or holes during
the pressing operation described above, the inclusion
of a reinforcing strip into the paper may optionally
also increase the security content of the document by
5 selecting a strip with openings of suitable size and
construction such that the presence of the strip in
the finished document produced from the paper is
detectable visually and/or by tactile means. These
means are available to the general public without any
10 special training or instruction. Optionally, the mesh
may be coloured and/or luminescent to further increase
the security content of the document and make the
presence of the strip more apparent.

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CLAIMS:

1. A reinforced fibrous sheet comprising an elongate security element and a reinforcing strip of material
5 having openings therein substantially embedded in the sheet between the elongate element and one surface of the sheet.
2. A reinforced fibrous sheet as claimed in claim 1
10 in which the elongate security element is substantially exposed at windows in an opposing surface of the sheet at a plurality of spaced locations.
3. A reinforced fibrous sheet as claimed in claim 1
15 or claim 2 in which the width of the reinforcing strip is in the range of 10 to 20mm.
4. A reinforced fibrous sheet as claimed in any one
20 of claims 1 to 3 in which the width of the elongate element lies in the range of 1 to 4mm.
5. A reinforced fibrous sheet as claimed in any one
25 of the preceding claims in which the papermaking fibres are natural, synthetic or a mixture thereof.
6. A reinforced fibrous sheet as claimed in any one
of the preceding claims in which the reinforcing strip is at least partially soluble.
30
7. A reinforced fibrous sheet as claimed in any one
of the preceding claims in which the reinforcing strip is coated, treated or configured to promote its
adhesion to the sheet.
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8. A reinforced fibrous sheet as claimed in any one of the preceding claims in which the reinforcing strip and elongate security element are bonded together.

5 9. A reinforced fibrous sheet as claimed in any one of the preceding claims in which the thickness and mesh opening size of the reinforcing strip are such that it provides a tactile effect in the finished sheet.

10 10. A reinforced fibrous sheet as claimed in any one of the preceding claims in which the reinforcing strip is coloured and/or luminescent.

15 11. A method of making a reinforced fibrous sheet generally incorporating a continuous elongate security element comprising the steps of continuously depositing fibres onto a support surface to form a sheet, continuously introducing an elongate element
20 and a reinforcing strip of a material having openings therein such that the elongate element is at least partially embedded within the sheet and the reinforcing strip lies between the elongate element and one surface of the sheet.

25 12. A method as claimed in claim 11 in which the security element is at least substantially exposed at windows in one surface of the sheet at a plurality of spaced locations, said support surface having spaced
30 portions into contact with which the elongate element is introduced before any significant deposition of fibres has occurred.

35 13. A method as claimed in claim 11 or claim 12 in which the reinforcing strip and security element are

introduced simultaneously.

14. A method as claimed in any one of claims 11 to 13
5 in which the reinforcing strip and security element
are bonded together before introduction.

15. A method as claimed in claim 11 or claim 12 in
which the security element is introduced before the
reinforcing strip such that it is first at least
10 partially embedded within the deposited fibres.

16. A method as claimed in any one of claims 11 to 15
in which the width of the reinforcing strip lies in
the range of 10 to 20mm.

15 17. A method as claimed in any one of claims 11 to 16
in which the width of the elongate element lies in the
range of 1 to 4mm.

20 18. A method substantially as hereinbefore described
with reference to and as shown in the accompanying
drawings.

25 19. A reinforced fibrous sheet substantially as
hereinbefore described with reference to and as shown
in the accompanying drawings.



Application No: GB 9605629.6
Claims searched: 1-19

Examiner: Alexander Littlejohn
Date of search: 2 May 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK CI (Ed.O): B6A (ATC); D1R (RBX)

Int CI (Ed.6): B42D 15/00; D21H 21/40, 21/42, 21/44

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
Y	GB2260772A (Portals) see e.g. page 7 lines 10-26	1-5,7, 10-13, 15-17
X	GB2103669A (Crane) see e.g. page 1 lines 97-117 and Fig 8	1-8,10-14, 16,17
X,Y	GB1365876 (Portals) see e.g. page 1 lines 13-26 and 69-89	X,Y:- 1-5,7, 10-13, 15-17
X	EP0070172A1 (Portals) see e.g. page 17 line 14 - page 18 line 15 and Figs 7-9	1-8,10-14, 16,17
Y	EP0059056A1 (Portals) see e.g. page 9 lines 15-26	1-5,7, 10-13, 15-17
Y	US1921504 (Chase) see e.g. page 1 lines 8-16	1-5,7, 10-13, 15-17

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.

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A Document indicating technological background and/or state of the art.
P Document published on or after the declared priority date but before the filing date of this invention.
E Patent document published on or after, but with priority date earlier than, the filing date of this application.

U S A M A K (USPTO)